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(54) **REPRESENTATION OF OVERLAPPING VISUAL ENTITIES**

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G09G 5/14 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G09G 5/14*** (2013.01); ***B25B 11/002*** (2013.01); ***G06F 17/30061*** (2013.01); ***G09B 29/007*** (2013.01); ***G11B 5/5569*** (2013.01); *G09G 2340/10* (2013.01); *Y10T 29/49998* (2015.01)

(58) **Field of Classification Search**
CPC G06F 17/30241
USPC 715/790
See application file for complete search history.

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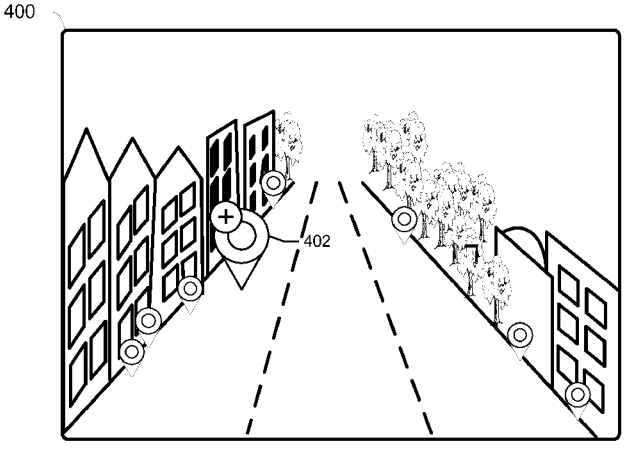
(57) **ABSTRACT**

Various embodiments present a combined visual entity that represents overlapping visual entities. The combined visual entity can include a primary visualization that represents one of the overlapping visual entities and annotations that represent others of the overlapping visual entities. For example, a map view can include multiple geographical entities that overlap. A primary visualization can be rendered that represents one of the multiple geographical entities. The primary visualization can be visually annotated (e.g., with symbols, letters, or other visual indicators) to indicate others of the multiple geographical entities. In some embodiments, a zoom operation can cause visual entities to be added and/or removed from the combined visual entity.

20 Claims, 18 Drawing Sheets



(51) **Int. Cl.**

G09B 29/00	(2006.01)
G11B 5/55	(2006.01)
B25B 11/00	(2006.01)
G06F 17/30	(2006.01)

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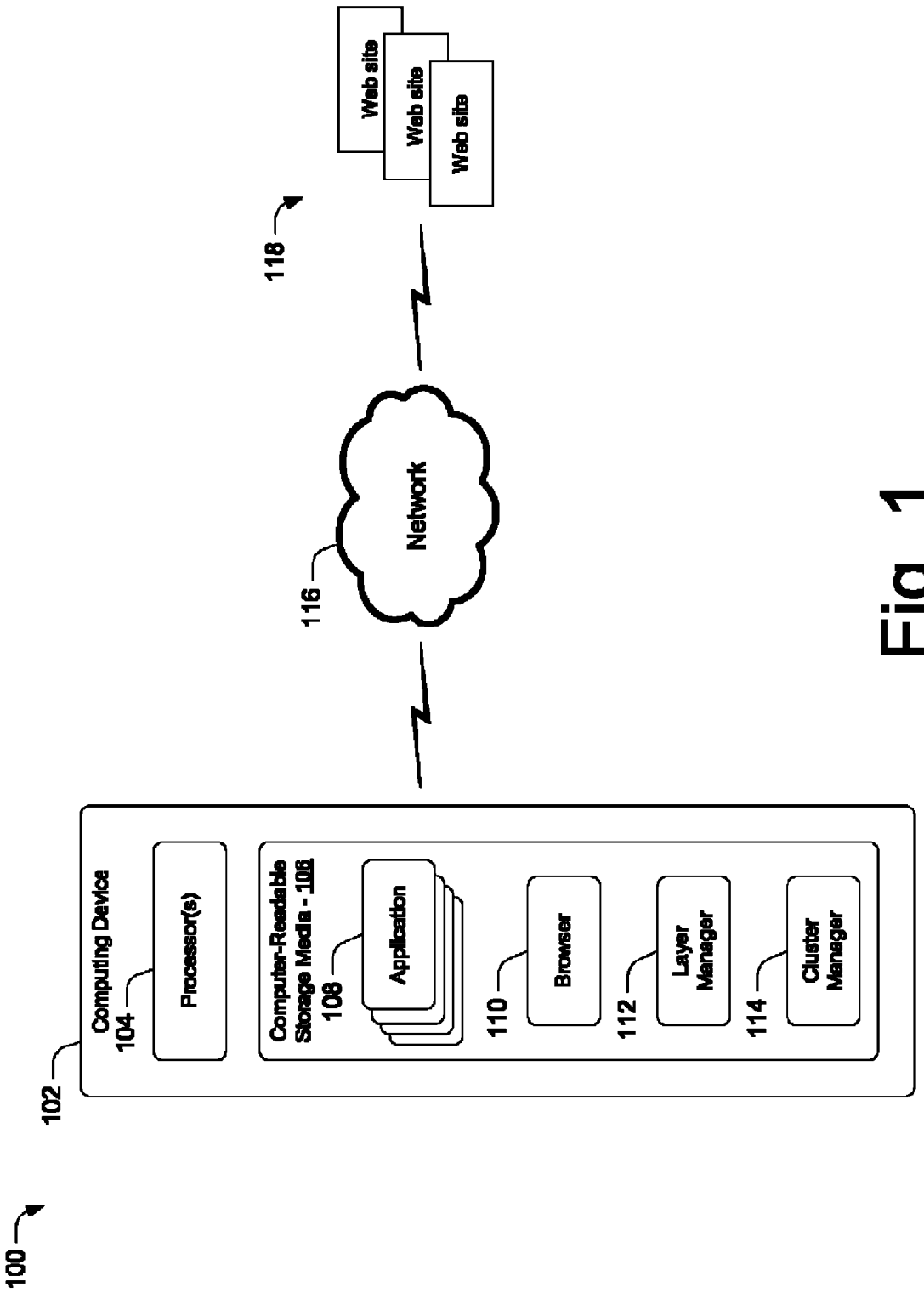
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104
Processor(s)
Computer-Readable Storage Media - 106
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Application
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Layer Manager
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Cluster Manager
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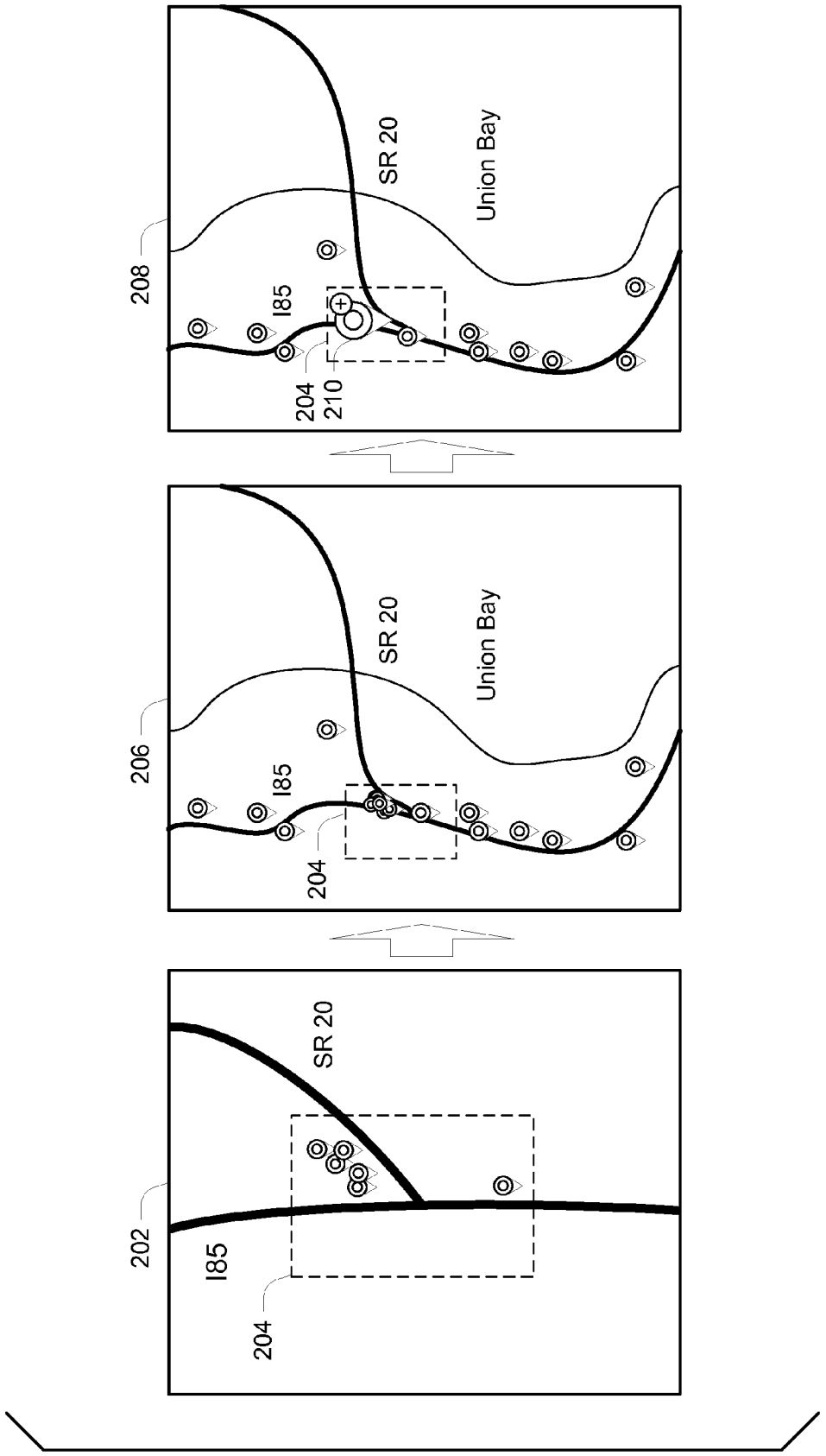
Network
118
Web site
Web site
Web site

Fig. 1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202
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I85
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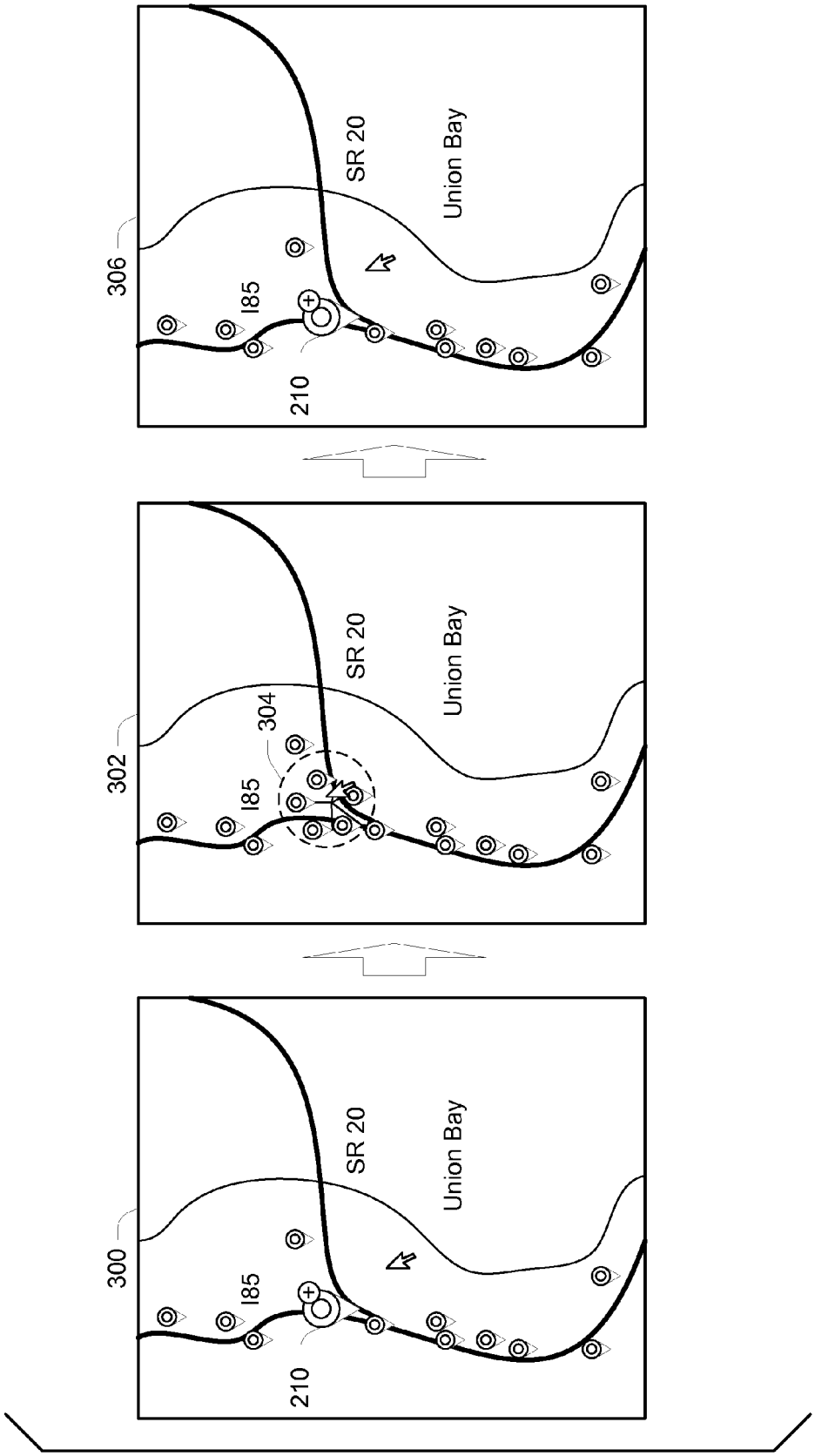
Fig. 2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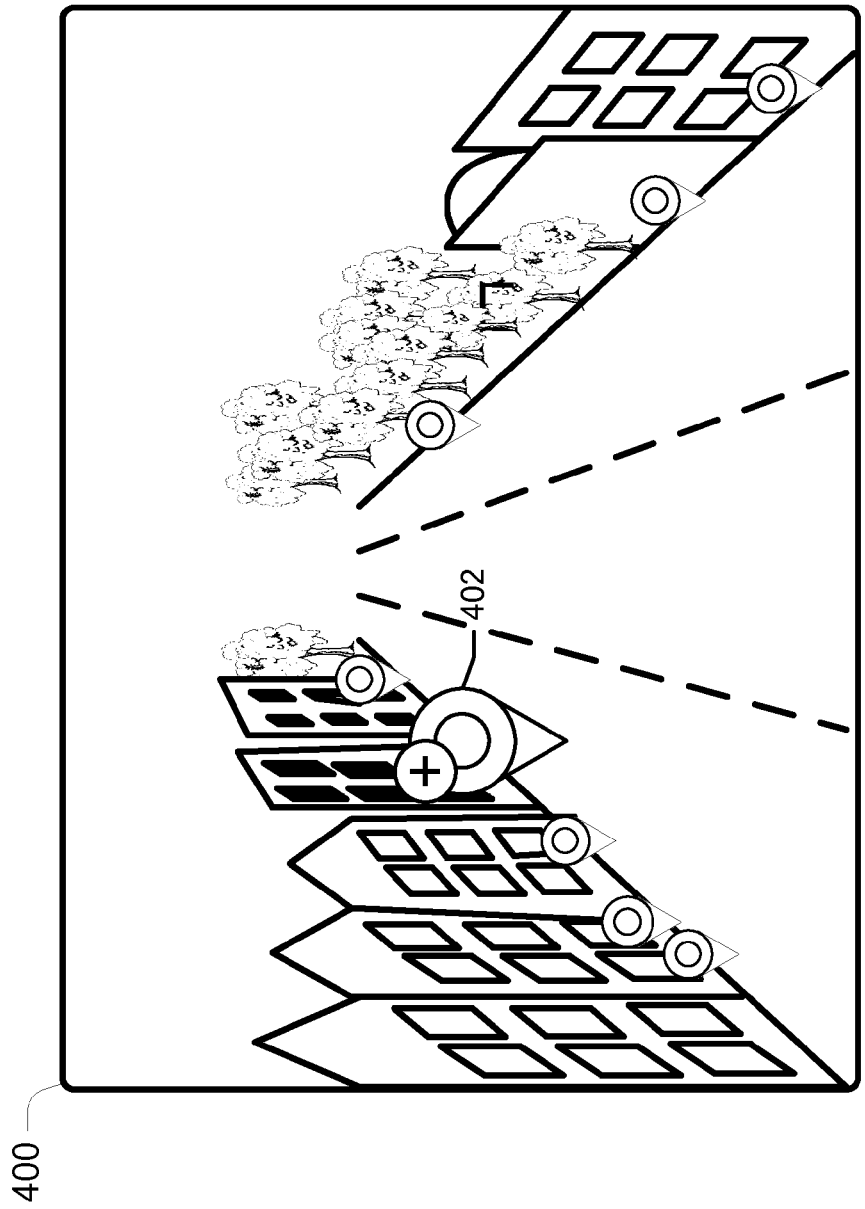

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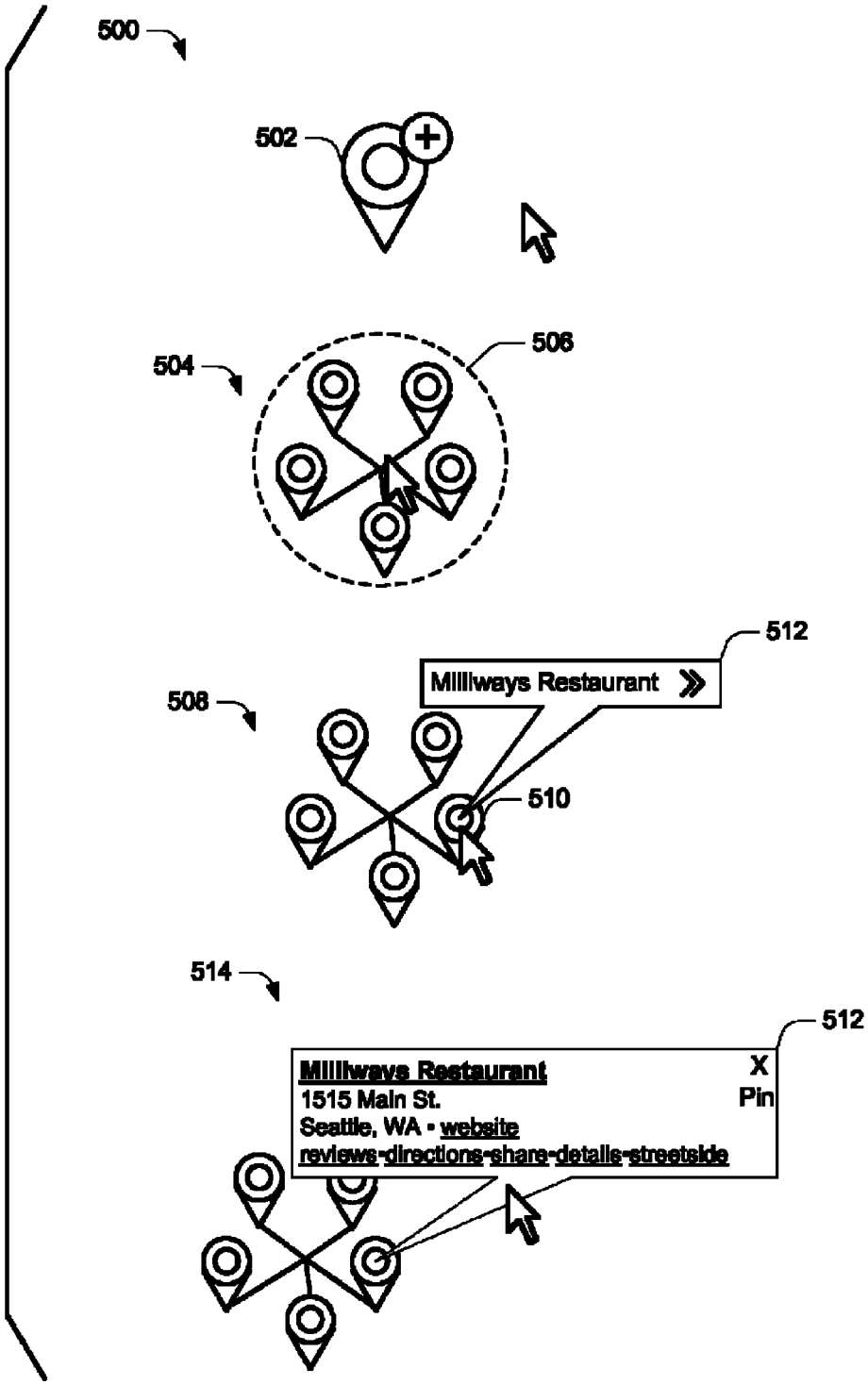
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506
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Millways Restaurant
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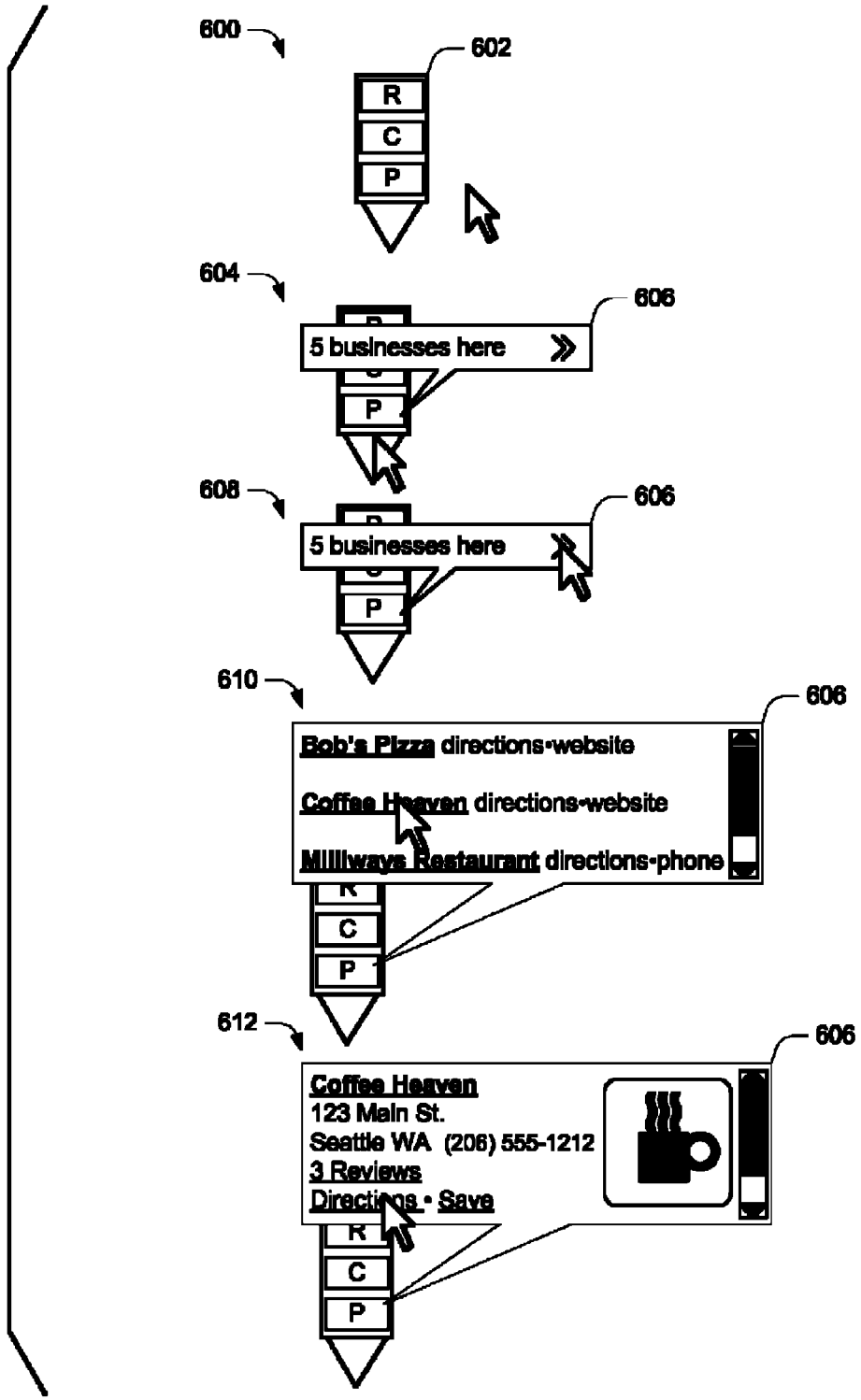
X
Pin

Fig. 5


600
602
R
C
P
604
606
5 businesses here
P
608
606
5 businesses here
P
610
606
Bob's Pizza directions·website
Coffee Heaven directions·website
Milllways Restaurant directions·phone
R
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606
Coffee Heaven
123 Main St.
Seattle WA (206) 555-1212
3 Reviews
Directions · Save
R
C
P

Fig. 6

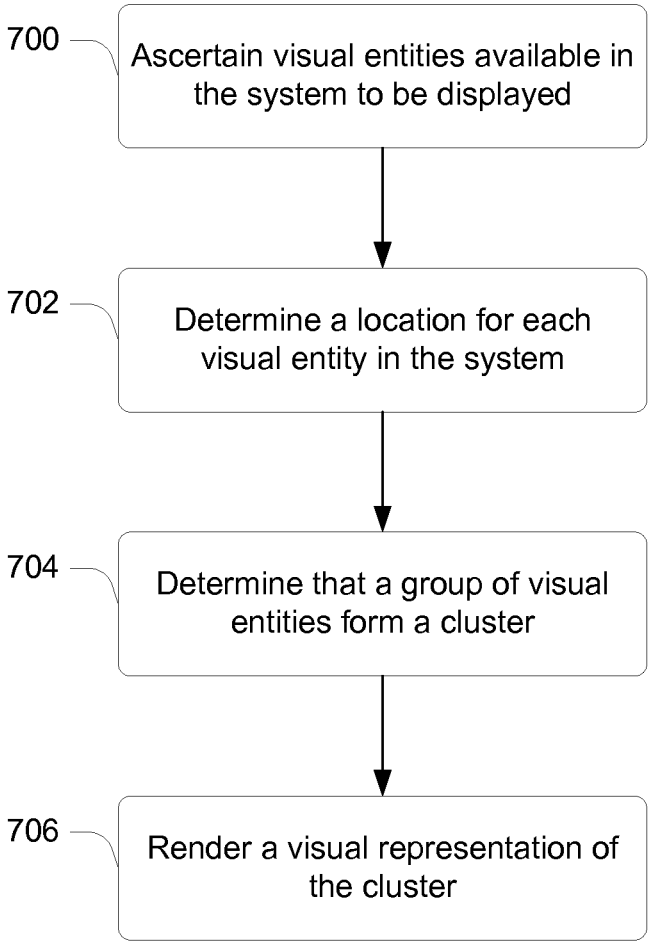

700
Ascertain visual entities available in the system to be displayed
702
Determine a location for each visual entity in the system
704
Determine that a group of visual entities form a cluster
706
Render a visual representation of the cluster

Fig. 7

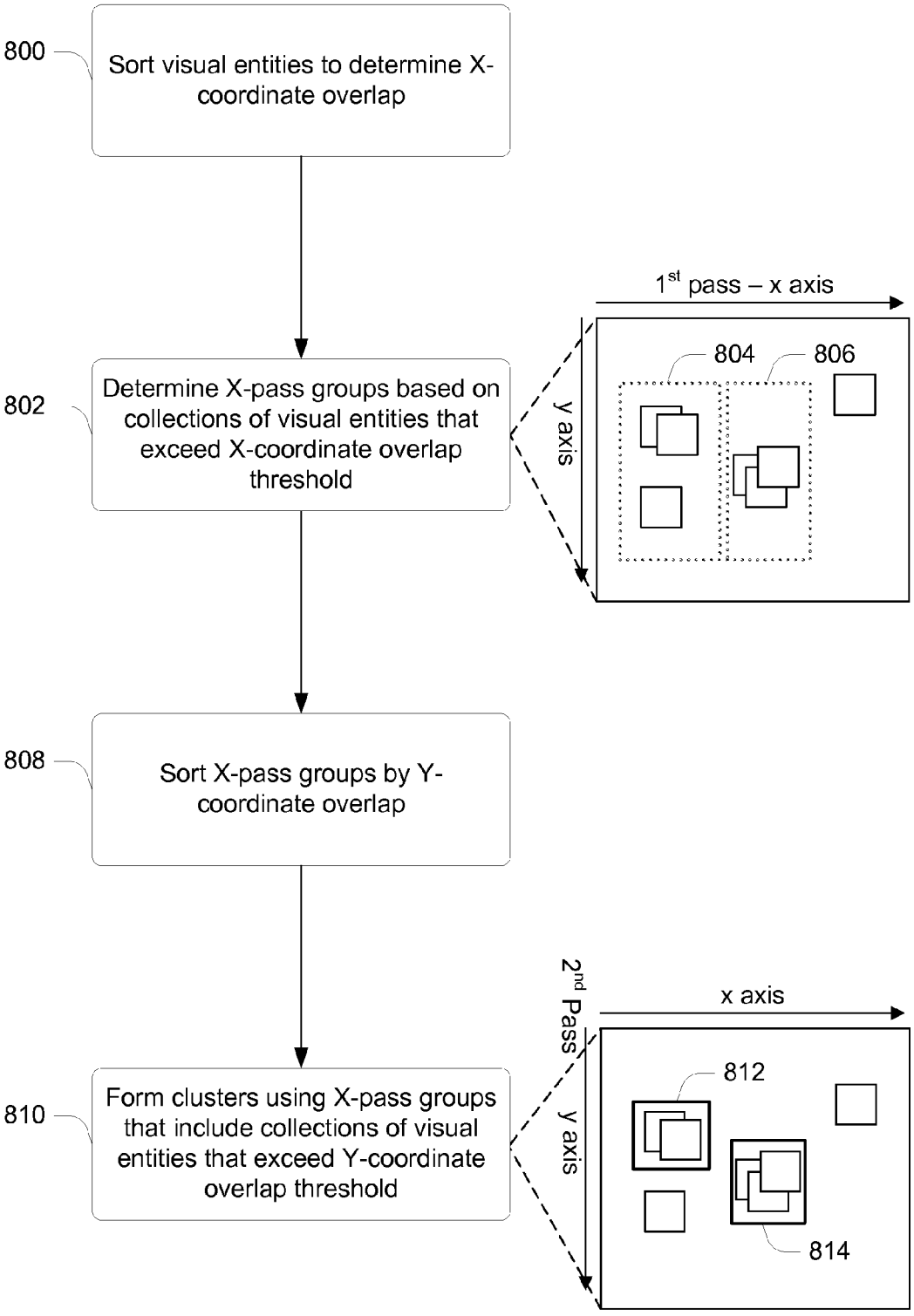

800
Sort visual entities to determine X-coordinate overlap
802
Determine X-pass groups based on collections of visual entities that exceed X-coordinate overlap threshold
1st pass – x axis
y axis
804
806
808
Sort X-pass groups by Y-coordinate overlap
810
Form clusters using X-pass groups that include collections of visual entities that exceed Y-coordinate overlap threshold
2nd Pass
x axis
y axis
812
814

Fig. 8

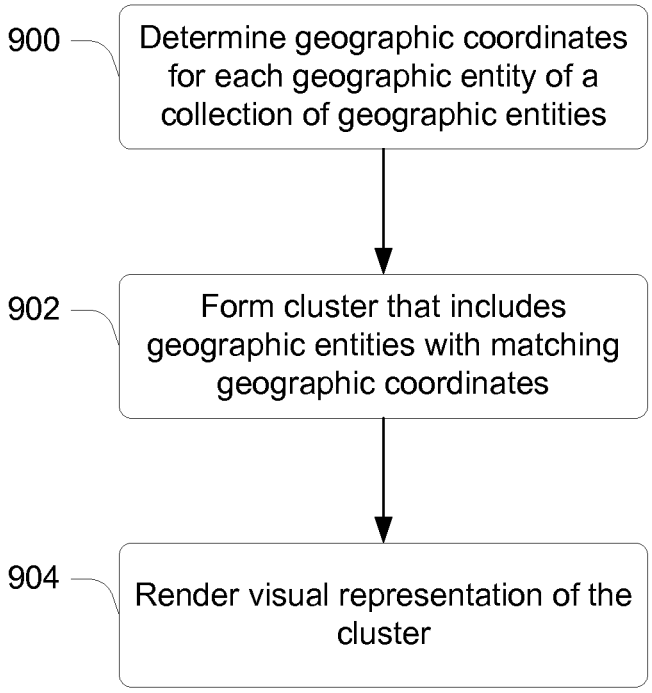

900
Determine geographic coordinates for each geographic entity of a collection of geographic entities
902
Form cluster that includes geographic entities with matching geographic coordinates
904
Render visual representation of the cluster

Fig. 9

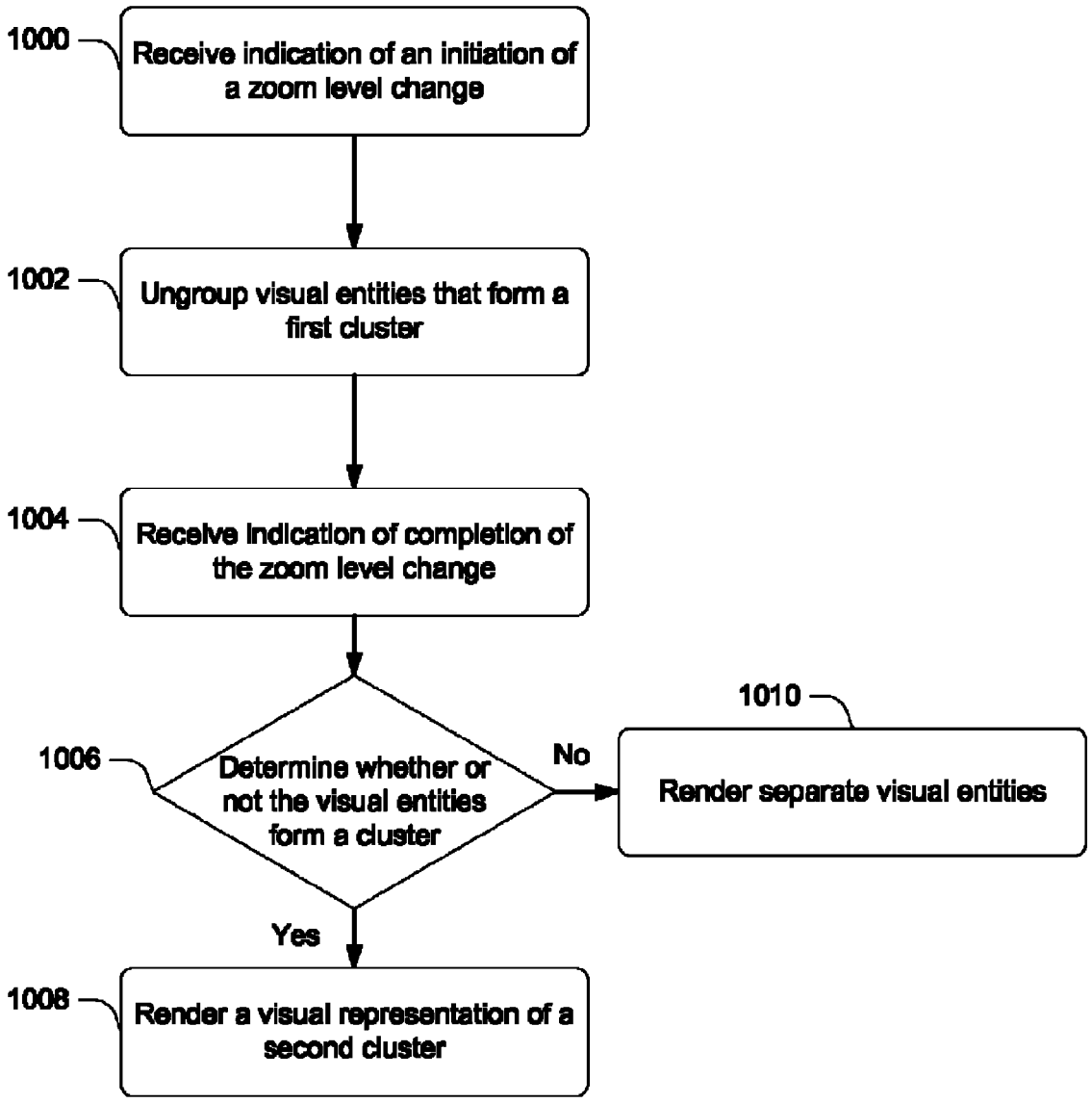

1000
Receive indication of an initiation of a zoom level change
1002
Ungroup visual entities that form a first cluster
1004
Receive indication of completion of the zoom level change
1006
Determine whether or not the visual entities form a cluster
No
1010
Render separate visual entities
Yes
1008
Render a visual representation of a second cluster

Fig. 10

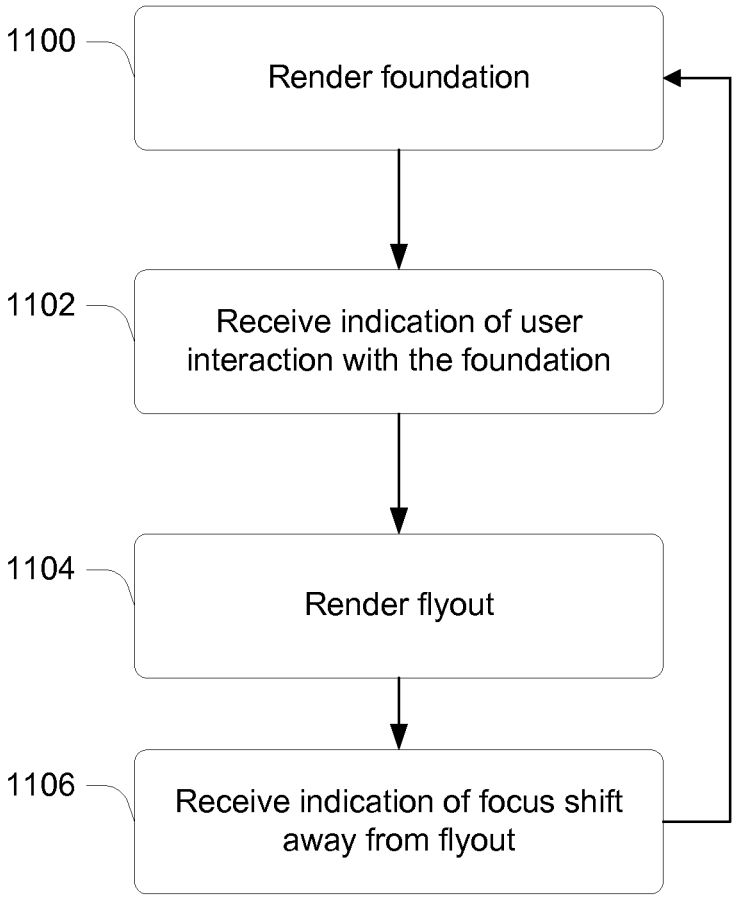

1100
Render foundation
1102
Receive indication of user interaction with the foundation
1104
Render flyout
1106
Receive indication of focus shift away from flyout

Fig. 11

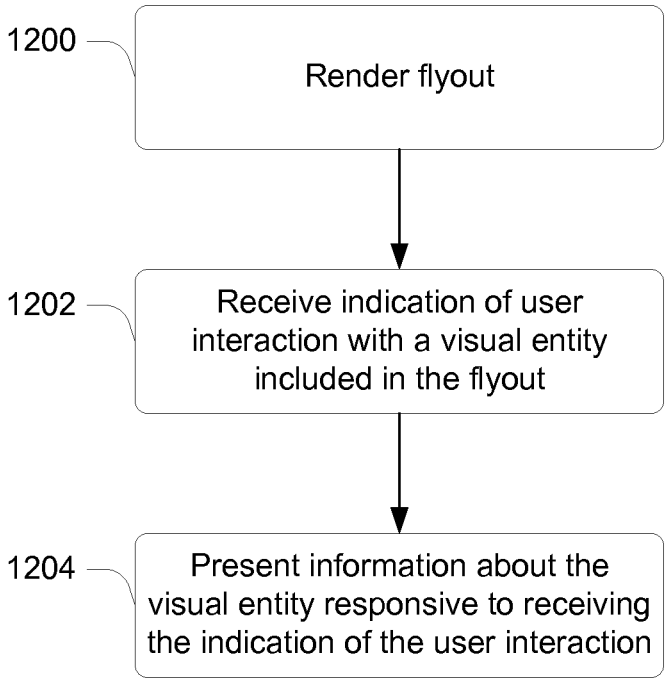
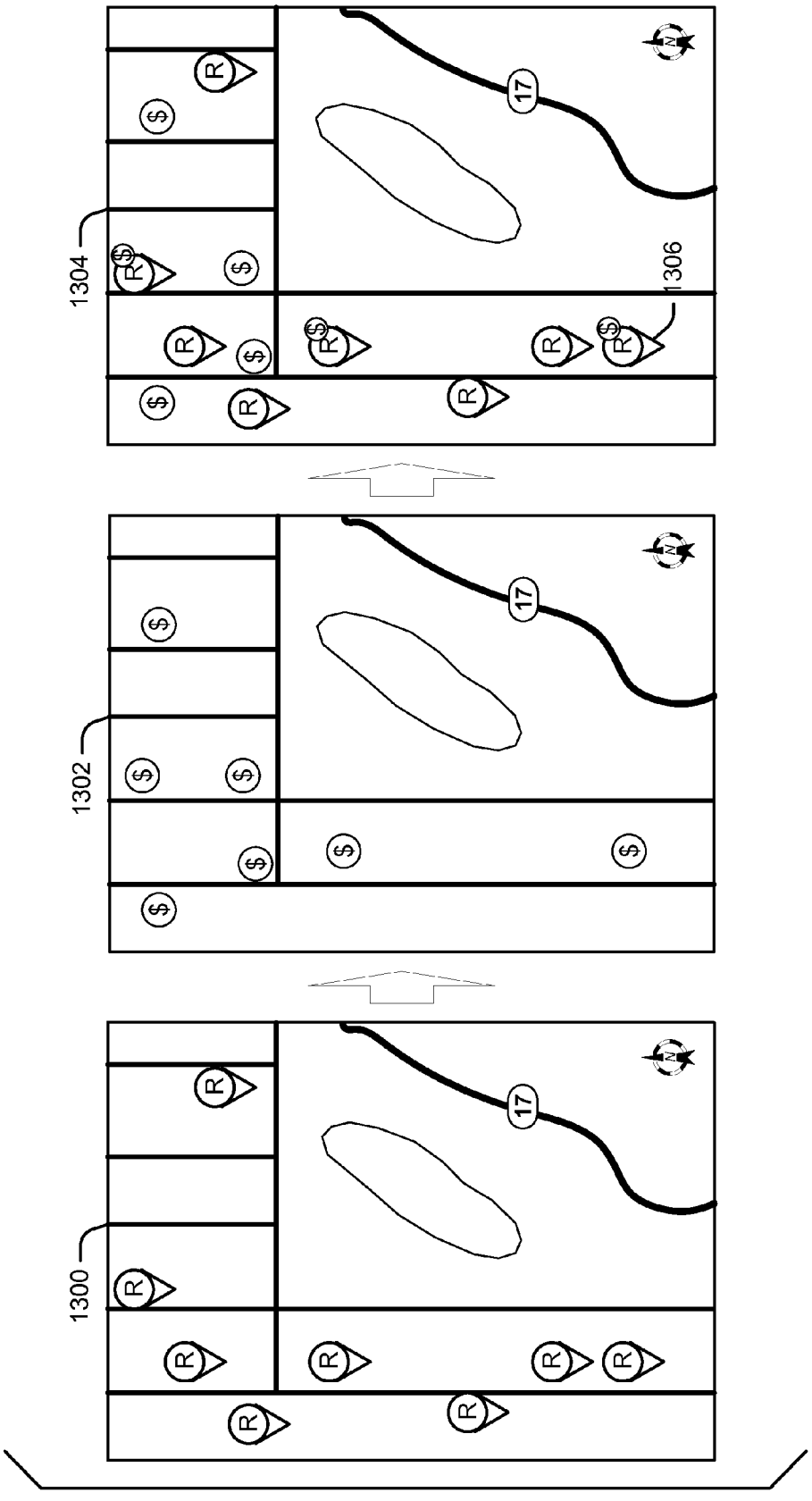

1200
Render flyout
1202
Receive indication of user interaction with a visual entity included in the flyout
1204
Present information about the visual entity responsive to receiving the indication of the user interaction

Fig. 12



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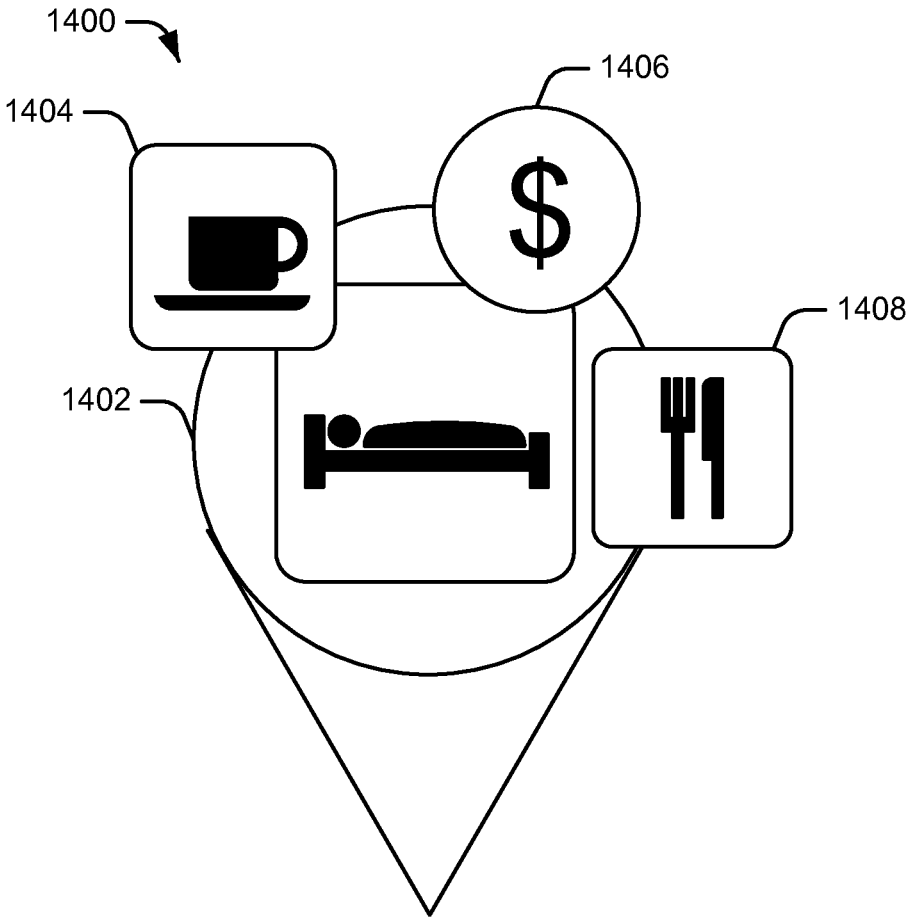

Fig. 14

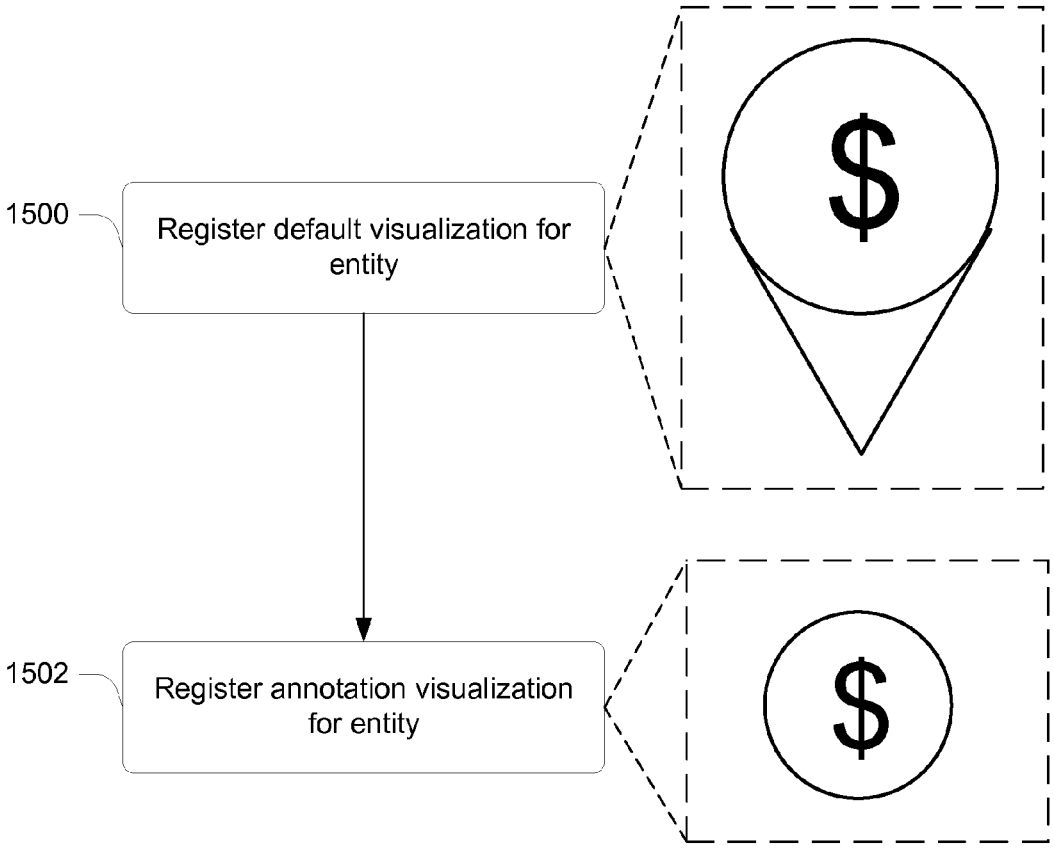
1500
Register default visualization for entity
$
1502
Register annotation visualization for entity
$

Fig. 15

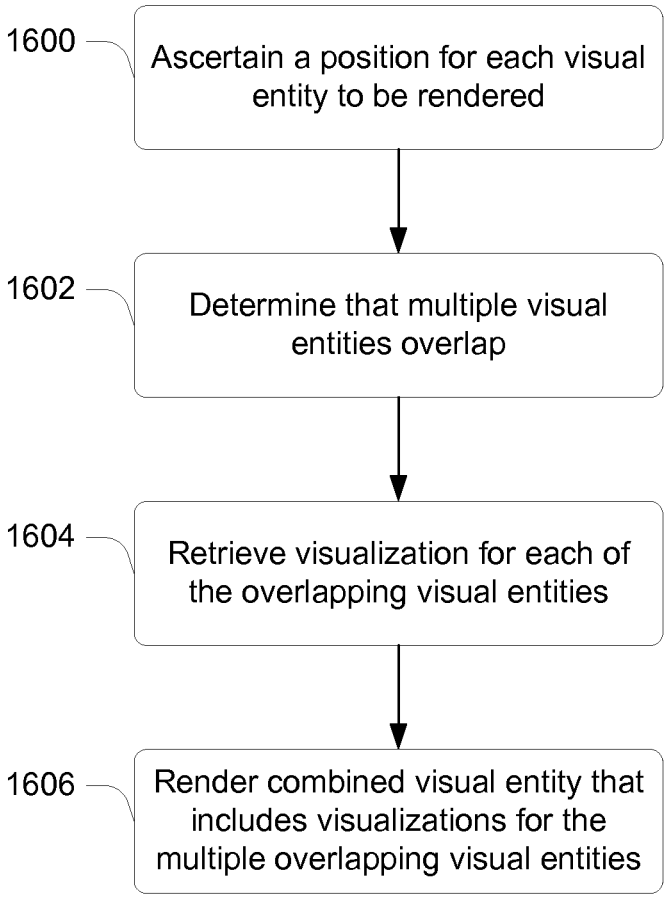
1600
Ascertain a position for each visual entity to be rendered
1602
Determine that multiple visual entities overlap
1604
Retrieve visualization for each of the overlapping visual entities
1606
Render combined visual entity that includes visualizations for the multiple overlapping visual entities

Fig. 16

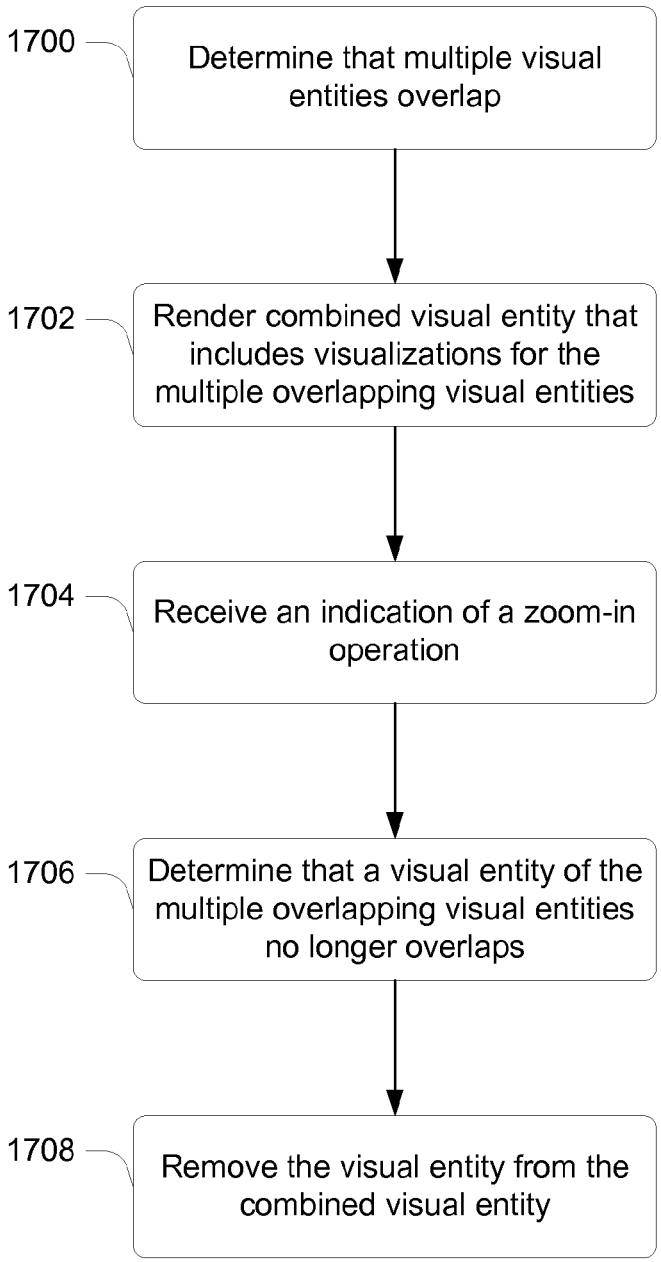
1700
Determine that multiple visual entities overlap
1702
Render combined visual entity that includes visualizations for the multiple overlapping visual entities
1704
Receive an indication of a zoom-in operation
1706
Determine that a visual entity of the multiple overlapping visual entities no longer overlaps
1708
Remove the visual entity from the combined visual entity

Fig. 17

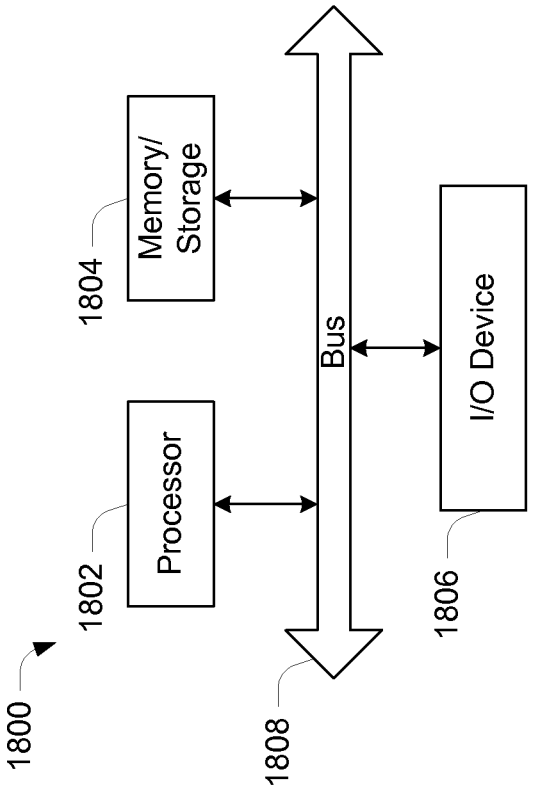
1800
1802
Processor
1804
Memory/
Storage
1806
I/O Device
1808
Bus

Fig. 18

REPRESENTATION OF OVERLAPPING VISUAL ENTITIES

RELATED APPLICATIONS

This application is a divisional of and claims priority to U.S. application Ser. No. 13/826,617, filed on Mar. 14, 2013, now issued U.S. Pat. No. 9,043,723, and entitled "Representation of Overlapping Visual Entities," which in turn is a continuation of and claims priority to U.S. application Ser. No. 12/764,798, filed on Apr. 21, 2010, which is now U.S. Pat. No. 8,423,902, and entitled "Representation of Overlapping Visual Entities," the disclosures of which are incorporated in their entirety by reference herein.

BACKGROUND

Due to the massive amount of data available for consumption in today's electronic environment, data visualization can be problematic. For example, a mapping application can have access to a multitude of locations (e.g., restaurants, banks, hotels, parks, and so on) that can be displayed as part of a map view. The sheer number of locations available for display, however, can cause a particular map view to become cluttered and reduce the usability of the map view.

SUMMARY

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

Various embodiments present a combined visual entity that represents overlapping visual entities. The combined visual entity can include a primary visualization that represents one of the overlapping visual entities and annotations that represent others of the overlapping visual entities. For example, a map view can include multiple geographical entities that overlap. A primary visualization can be rendered that represents one of the multiple geographical entities. The primary visualization can be visually annotated (e.g., with symbols, letters, or other visual indicators) to indicate others of the multiple geographical entities. In some embodiments, a zoom operation can cause visual entities to be added and/or removed from the combined visual entity.

In some embodiments, overlapping visual entities are grouped into a cluster that can be opened to reveal individual visual entities that form the cluster. According to one or more embodiments, a cluster is represented on a map by a visual representation known as a foundation. A user can interact with the foundation to cause the cluster to be opened to reveal a flyout that includes individual visual entities that form the cluster. In some embodiments, the visual entities can represent geographical locations in a map view. A user can also interact with an individual visual entity of the flyout to acquire more information about the visual entity.

BRIEF DESCRIPTION OF THE DRAWINGS

The same numbers are used throughout the drawings to reference like features.

FIG. **1** illustrates an operating environment in which various principles described herein can be employed in accordance with one or more embodiments.

FIG. **2** illustrates how a cluster of visual entities can be visualized in accordance with one or more embodiments.

FIG. **3** illustrates how a foundation can be expanded to reveal a flyout in accordance with one or more embodiments.

FIG. **4** illustrates how a foundation can be used to illustrate a cluster in a street view scenario in accordance with one or more embodiments.

FIG. **5** illustrates how interaction with a flyout can cause information about a flyout entity to be presented in accordance with one or more embodiments.

FIG. **6** illustrates how interaction with a flyout can cause information about a flyout entity to be presented in accordance with one or more embodiments.

FIG. **7** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **8** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **9** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **10** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **11** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **12** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **13** illustrates how overlapping data sets can be visualized in accordance with one or more embodiments.

FIG. **14** illustrates an example combined visual entity in accordance with one or more embodiments.

FIG. **15** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **16** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **17** is a flow diagram that describes steps in a method in accordance with one or more embodiments.

FIG. **18** illustrates an example system that can be used to implement one or more embodiments.

DETAILED DESCRIPTION

Overview

Various embodiments present a combined visual entity that represents overlapping visual entities. The combined visual entity can include a primary visualization that represents one of the overlapping visual entities and annotations that represent others of the overlapping visual entities. For example, a map view can include multiple geographical entities that overlap. A primary visualization can be rendered that represents one of the multiple geographical entities. The primary visualization can be visually annotated (e.g., with symbols, letters, or other visual indicators) to indicate others of the multiple geographical entities. In some embodiments, a zoom operation can cause visual entities to be added and/or removed from the combined visual entity.

In some embodiments, overlapping visual entities are grouped into a cluster that can be opened to reveal the individual visual entities that form the cluster. A visual entity can represent a data entity, such as a geographical location, a business, a residence, an instance of content, a data file, and so on. In some example operating scenarios, overlapping visual entities can represent geographical locations on a map that are combined to form a cluster, and the cluster can be opened to reveal the individual geographical locations that form the cluster. In at least some embodiments, the cluster can be opened independent of a zoom operation.

According to one or more embodiments, a cluster is represented on a map by a visual representation known as a foundation. A user can interact with the foundation to cause the cluster to be opened to reveal a flyout that includes individual visual entities (e.g., geographic locations) that form the cluster. A user can also interact with an individual entity of the flyout to acquire more information about the entity. In at least some embodiments, user interaction can include hovering operations, proximity operations (e.g., user interaction within a certain proximity of a foundation or other entity), clicking operations, keyboard selection operations, touch operations, and the like.

In the discussion that follows, a section entitled "Operating Environment" is provided and describes one example environment in which one or more embodiments can be employed. Following this, a section entitled "Example Cluster Visualizations" describes how clusters of entities can be visualized in accordance with one or more embodiments. Next, a section entitled "Constructing and Interacting with Clusters" describes how a cluster can be formed and how a visualization of a cluster can be interacted with in accordance with one or more embodiments. Following this, a section entitled "Representation of Overlapping Visual Entities" describes how a combined visualization can be used to visually indicate overlapping data sets in accordance with one or more embodiments. Last, a section entitled "Example System" describes an example system that can be utilized to implement one or more embodiments.

Consider now an example operating environment in which one or more embodiments can be implemented.

Operating Environment

FIG. **1** illustrates an operating environment in accordance with one or more embodiments, generally at **100**. Environment **100** includes a computing device **102** having one or more processors **104**, one or more computer-readable storage media **106** and one or more applications **108** that reside on the computer-readable storage media and which are executable by the processor(s). The computer-readable storage media can include, by way of example and not limitation, all forms of volatile and non-volatile memory and/or storage media that are typically associated with a computing device. Such media can include ROM, RAM, flash memory, hard disk, removable media and the like. One specific example of a computing device is shown and described below in FIG. **18**.

In addition, computing device **102** includes a software application in the form of a web browser **110**. Any suitable web browser can be used examples of which are available from the assignee of this document and others. In addition, computer-readable storage media **106** can include a layer manager **112** and a cluster manager **114** that are configured to operate as described below. Each of layer manager **112** and cluster manager **114** can be implemented as a standalone component that can be utilized by applications **108** and/or browser **110**. Alternately or additionally, layer manager **112** and/or cluster manager **114** can be implemented as part of applications **108** and/or browser **110**. Examples of Applications **108** can include a mapping platform (e.g., utilizing 2D and/or 3D maps), an operating system, a file explorer, and so on.

In operation, layer manager **112** handles layers of data for the applications **108**. For example, a mapping application can include multiple layers of map data that can be used to populate a map view. Each of the multiple layers can include different types of entities and map data. For example, a first layer may include restaurants, a second layer may include educational institutions, a third layer may include locations defined by an end-user, and so on. In some embodiments, multiple layers can be overlaid, one on another, to create a particular map view. To manage layer data, layer manager **112** is configured to handle a variety of different tasks, such as tracking a location for a visual entity, maintaining different visual forms for a visual entity, managing the z-order (e.g., layer order) of different layers and/or visual entities, and so on.

In at least some embodiments, cluster manager **114** works in a mapping context to enable various visual entities to be grouped into a cluster. A visual entity can represent a data entity, such as a geographical location, an instance of media content, a data file, and the like. The cluster manager can group visual entities into a cluster by determining overlap between visual entities in a particular display region. When a particular group of visual entities overlap by at least a threshold amount, the group of visual entities can be formed into a cluster. Overlap can be measured using a variety of different metrics, such as screen pixels, world-coordinates (e.g., GPS coordinates, latitude, longitude, and so on), street addresses, and so on. Example ways of determining overlap are discussed below.

According to some embodiments, layer manager **112** and cluster manager **114** are configured to interact and communicate to group visual entities into clusters and to place visual entities and clusters in a particular display view. Layer manager **112** can provide cluster manager **114** with different types of information that can be used by the cluster manager to create and manage clusters. Examples of this information include:

Entity list: This is a list of visual entities and/or data entities in a particular system. For example, in a map scenario, this can include a list of geographic entities and visual representations of the geographic entities that are available to populate a map.

Visible entities: This is a list of the visual entities that are in a current view. For example, this may include geographical entities that are represented in a current map view.

Existing clusters: This is a list of clusters that are currently in existence.

Visual entities: This includes a location and dimension for each visual entity. For example, this information may include a location (e.g., in screen coordinates) and a dimension (e.g., in pixels relative to the screen coordinates) of a visual entity.

Z-order: This includes a z-order for visual entities, clusters, and/or layers in a particular system. For example, a particular visual entity can have a z-order that indicates that the entity is to be displayed above (e.g., occlude) other visual entities in a display view.

Entity status: This indicates changes in entity status for a particular render pass. For example, this information can indicate that an entity was added, removed, or changed z-order for a particular render pass. In some embodiments, the term "render pass" refers to a re-draw of entities in a display view. A render pass can occur responsive to changes in a display view, such as a zoom operation, the addition or removal of entities, a change in cluster membership, and so on.

Layer Membership: This indicates which entities belong to which layer and an order for each of the layers in a layer set.

In some embodiments, cluster manager **114** can receive some or all of this information from layer manager **112**, process the information, and generate further information

that can be passed back to the layer manager to populate a particular display view. Examples of this further information can include:

(1) Updated entity list: This can include an updated list of entities (including cluster entities) and a list of entities that were removed from existing clusters.

(2) Entity layers: This can include a list of layers that include entities included in clusters.

(3) Cluster membership: This can include an indication of a cluster membership for an entity.

(4) Entity change: This can include an indication of visual entities and/or clusters that should be added or removed from a display view.

(5) Cluster z-order: This can include a z-order for entities in a particular cluster.

(6) Visual elements: This can include a visual representation to be used to represent a cluster. In some embodiments, each of multiple clusters can be associated with a unique visual representation.

In addition the above-mentioned features, environment **100** includes a network **116**, such as the Internet, and one or more web sites **118** from and to which content can be received and sent. Such content can include map content that can be operated upon by layer manager **112** and/or cluster manager **114**, as described above and below. It is to be appreciated and understood that the layer manager and/or the cluster manager can reside on a server or network-accessible computer, other than computing device **102**.

Computing device **102** can be embodied as any suitable computing device such as, by way of example and not limitation, a desktop computer, a portable computer, a handheld computer such as a personal digital assistant (PDA), cell phone, a mobile device, and the like.

Although not expressly illustrated in FIG. **1**, environment **100** can include a plug-in framework (e.g., embodied on computing device **102**) that enables developers, programmers, and other parties to utilize the techniques and processes discussed herein in separate implementations.

Having described an example operating environment, consider now a discussion of example clusters in accordance with one or more embodiments.

Example Cluster Visualizations

FIG. **2** illustrates one example way in which multiple overlapping visual entities can be visualized as a cluster in a mapping context in accordance with one or more embodiments. A map view **202** displays a group of visual entities and includes a map region **204**. A map view **206** illustrates a map view that is displayed after a zoom-out operation occurs on map view **202**. The map view **206** includes map region **204** as well as additional visual entities. As illustrated in map view **206**, the increase in the map scale resulting from the zoom-out operation has caused visual entities within map region **204** to be grouped together such that some visual entities visually occlude other visual entities.

Further illustrated in FIG. **2** is a map view **208** that includes map region **204** and a foundation **210**. In accordance with some embodiments, foundation **210** is a visual representation of a cluster that is created using visual entities from map region **204**. Thus, the overlapping group of visual entities displayed in map region **204** of map view **206** can be replaced with foundation **210**. Foundation **210** can represent a unified visual representation that a user can interact with to view visual entities included in the cluster and to find out more information about the visual entities.

In some embodiments, a visualization for a foundation can be defined for an application by an application developer and/or the visualization can be selected by an end-user. Thus, at least in some embodiments, a visualization for a foundation is customizable to provide a unique visual appearance for a cluster.

FIG. **3** illustrates one example way in which user interaction with a foundation can reveal visual entities that form a cluster in accordance with one or more embodiments. A map view **300** includes the foundation **210** discussed above with reference to FIG. **2**. At a map view **302**, a user has placed a cursor over the foundation **210** (e.g., by manipulating the cursor with a mouse), which has caused a flyout **304** to replace foundation **210**. Flyout **304** includes visual entities that form the cluster represented by foundation **210**. As illustrated, the visual entities are tied together as part of flyout **304** by graphic lines, indicating that the visual entities represent clustered entities and that the visual entities may not be displayed at a correct location for an underlying data entity.

In some embodiments, a visualization for a flyout can be defined for an application by an application developer and/or the visualization can be selected by an end-user. Thus, at least in some embodiments, a flyout visualization is customizable to provide a unique visual appearance for visual entities in a cluster.

At a map view **306**, the user has moved the cursor away from flyout **304**, thus causing flyout **304** to be replaced with foundation **210**. Thus, in some embodiments, foundation **210** and flyout **304** have a dynamic relationship that responds to user interaction with the foundation and/or the flyout.

FIG. **4** illustrates one example way of using a foundation to represent a cluster in a street view paradigm in accordance with one or more embodiments. As part of FIG. **4** are a street view **400** and a foundation **402**. In some embodiments, street view **400** is a two-dimensional approximation of a three-dimensional view. For example, street view **400** can approximate the view of a person who is traveling (e.g., walking or driving) along a street. In the street view context, some visual entities can occlude other visual entities. For example, if several visual entities are located at the same address (e.g., in an office building), the visual entities can become cluttered and some of the visual entities can partially or totally occlude others. Thus, a foundation/flyout combination (represented by foundation **402**) can be used to represent a cluster of visual entities at a particular location in street view **400**.

In some embodiments, the design of a foundation and/or flyout can be configured to convey meaning in a particular context. For example, a visualization for a foundation can include a building at a particular location and an associated flyout can include a map of different locations within the building.

FIG. **5** illustrates one example way of interacting with a foundation to view visual entities in a cluster in accordance with one or more embodiments. At **500**, a foundation **502** is illustrated. As discussed above and below, in some embodiments a foundation is a visual representation of clustered entities. At **504**, user interaction with foundation **502** causes an underlying cluster to open and reveal a flyout **506**. At **508**, user interaction with a visual entity **510** reveals information about visual entity **510**. In this particular example, the information is included in a popup window **512**.

At **514**, user interaction with the popup window **512** causes the popup window to expand and reveal further information about the visual entity **510**. In this particular example embodiment, the further information includes selectable links that can be selected to navigate to functionality associated with the represented entity.

FIG. **6** illustrates an alternative embodiment of a foundation/flyout combination in accordance with one or more embodiments. At **600**, a foundation **602** is displayed that represents a cluster of visual entities. In this particular example embodiment, foundation **602** is annotated to indicate aspects of one or more of the visual entities of the underlying cluster. For example, foundation **602** includes an "R" which indicates that one of the entities is a restaurant, a "C" which indicates that one of the entities is a coffee shop, and a "P" which indicates that one of the entities is associated with parking.

At **604**, user interaction with foundation **602** causes a popup window **606** to be displayed. At **608**, a user interacts with the popup window **606**. According to some embodiments, user interaction with popup window **606** can include causing a cursor to hover over the popup window. At **610**, the user interaction with popup window **606** causes the popup window to expand to reveal more information about visual entities included in the cluster represented by foundation **602**. In this particular example embodiment, the information includes a scrollable list of business entities that are part of the cluster. At **612**, user interaction with one of the listed business entities causes popup window **606** to be populated with more information about the business entity.

Constructing and Interacting with Clusters

FIG. **7** is a flow diagram that describes steps in a method in accordance with one or more embodiments. The method discussed with reference to FIG. **7**, in addition to any other of the methods discussed herein, can be implemented in connection with any suitable hardware, software, firmware or combination thereof. In at least some embodiments, aspects of the methods discussed herein can be implemented by software modules, such as layer manager **112** and/or cluster manager **114** discussed in FIG. **1**. It is to be appreciated and understood that the methods discussed herein can be performed by a suitably-configured server, a network-accessible computing device, and/or a client computing device.

Step **700** ascertains visual entities that are available in the system to be displayed. For example, in a mapping scenario, the visual entities can represent geographical locations that can occur in a particular map view. The visual entities can be stored at a local resource (e.g., computing device **102**) and/or available from a remote resource. Step **702** determines a location for each visual entity in the system. In some embodiments, the location may be in terms of screen location (e.g., screen coordinates), real-world location (e.g., GPS coordinates, street address, latitude/longitude coordinates, and so on), computer directory location, and so on. Step **704** determines that a group of visual entities forms a cluster. Example ways of performing step **704** are discussed in more detail below. Step **706** renders a visual representation of the cluster. Example visual representations of a cluster are discussed above (e.g., a foundation) and below.

According to some embodiments, a data entity can opt in or opt out of the clustering process. For example, when a particular data entity opts into the clustering process, a visual entity that represents the data entity will be considered when determining clusters. When a particular data entity opts out of the clustering process, however, a visual entity that represents the data entity will be omitted when determining clusters.

As an illustration of this notion, consider the following example implementation scenario involving a tourist attraction data entity. When the tourist attraction registers with a particular data layer (e.g., to be included in a map), the tourist attraction provides an indication that it is opting out of the clustering process. When the clustering process is performed for a map region where the tourist attraction occurs, the tourist attraction is not considered in forming a cluster. Thus, according to some embodiments, the clustering process would normally group a visual representation of the tourist attraction with other visual entities to form a cluster. Since the tourist attraction has opted out of the clustering process, however, a visual representation of tourist attraction is not included as part of a cluster, e.g., as part of a foundation. Thus, in some embodiments, a visual representation of the tourist attraction can be rendered separately from an adjacent foundation.

FIG. **8** is a flow diagram that describes steps in a method in accordance with one or more embodiments. In some embodiments, the method can be implemented to form a cluster that includes multiple visual entities. Step **800** sorts visual entities to determine x-coordinate overlap. In some embodiments, a configurable x-coordinate threshold overlap can be specified that can be used to determine if two or more visual entities overlap such that they can be members of a cluster. For example, with respect to x-coordinate overlap, a threshold overlap of N pixels can be specified. When two or more visual entities overlap by N pixels or more as projected on an x-axis, the visual entities can be considered an x-pass group for purposes of a preliminary cluster determination. In some embodiments, the acts of sorting discussed above and below can be accomplished in linear time using a linear sort algorithm (e.g., Radix sort).

Step **802** determines x-pass groups based on collections of visual entities that exceed an x-coordinate overlap threshold. As illustrated in the projection from step **802**, the entities within box **804** and box **806** exceed an x-pass overlap threshold and thus are grouped as x-pass groups. Step **808** sorts the x-pass groups by y-coordinate overlap.

Step **810** forms clusters using x-pass groups that include collections of visual entities that exceed a y-coordinate overlap threshold. A configurable threshold y-coordinate overlap can be specified or the threshold x-coordinate overlap discussed above can be utilized in sorting the x-pass groups by y-coordinate overlap. As illustrated in the projection from step **810**, a cluster **812** and a cluster **814** have been formed as a result of step **810**.

In some embodiments, a maximum number of visual entities permitted in a cluster can be specified. For example, a maximum of 5 visual entities per cluster can be specified. If a cluster exceeds the maximum number of visual entities, the cluster can be broken up into separate clusters and/or visual entities can be removed from the cluster until it reaches the maximum size. Although not expressly illustrated in FIG. **8**, a final step can be performed whereby clusters that exceed a maximum number of visual entities can be broken up into multiple clusters (e.g., two or more smaller clusters) and/or visual entities can be removed from a cluster that exceeds a maximum number of visual entities. In some embodiments, visual entities that are removed from a cluster can be displayed separately from a foundation.

FIG. **9** is a flow diagram that describes steps in a method in accordance with one or more embodiments. In some embodiments, the method can be implemented to form a cluster that includes multiple geographic entities. Examples of geographic entities include street addresses, businesses, residential locations, and so on. Step **900** determines geographic coordinates for each geographic entity of a collection of geographic entities. Examples of geographic coordinates include latitude coordinates, longitude coordinates, GPS coordinates, and so on. Step **902** forms a cluster that includes geographic entities with matching geographic coor-

dinates. One example way of performing step **902** is to compute a hash value using geographical coordinates for each geographic entity. For example, a one-pass linear bucketing of the geographical coordinates can be performed. Geographic entities with identical and/or similar hash values are then grouped together to form a cluster.

Step **904** renders a visual representation of the cluster. According to some embodiments, this method of forming clusters can be useful in a street view scenario (see, e.g., the discussion above with respect to FIG. **4**) to form clusters using geographical entities that occur at the same or similar location (e.g., a particular street address).

The methods discussed herein for determining entity overlap and/or forming clusters are provided for purposes of example only and are not to be interpreted as limiting the claimed subject matter. It is to be appreciated that a variety of different methods and techniques can be utilized to form clusters without departing from the spirit and scope of the claimed embodiments. For example, some techniques can simply look at pixel occlusion, some can consider the shape of entities in forming a cluster (e.g., utilizing a shape collision detection algorithm), and so on.

While certain embodiments are discussed herein with respect to forming clusters based on entity overlap, some embodiments can additionally or alternatively form clusters utilizing entities that are like or similar in nature. For example, some clustering techniques can form clusters using similar entities, such as a restaurant cluster, a tourist attraction cluster, a coffee shop cluster, and so on. Thus, in some embodiments, a cluster-forming technique can consider the proximity and/or overlap of entities and can also consider the nature of each of the entities. For example, if two entities are of disparate types (e.g., one is a restaurant and the other is a sporting goods store), the two entities may not be included in the same cluster.

FIG. **10** is a flow diagram that describes steps in a method in accordance with one or more embodiments. In some embodiments, the method can be implemented to cluster and/or de-cluster entities in response to a zoom operation. Step **1000** receives an indication of an initiation of a zoom level change. According to some embodiments, step **1000** can be performed responsive to user interaction with a zoom (e.g., zoom-in or zoom-out) function. Step **1002** ungroups visual entities that form a first cluster. In some embodiments, the first cluster can be ungrouped responsive to receiving the indication of the zoom level change. Step **1004** receives an indication of completion of the zoom level change. In some embodiments, the zoom level change can include a zoom-in and/or a zoom-out operation.

Step **1006** determines whether or not the visual entities form a cluster. Example ways of determining that visual entities form a cluster are discussed above and below. If the visual entities form a cluster ("Yes"), step **1008** renders a visual representation of a second cluster. In some embodiments, the second cluster may include the same visual entities as the first cluster, fewer visual entities than the first cluster, or more visual entities than the first cluster. If the visual entities do not form a cluster ("No"), step **1010** renders separate visual entities.

FIG. **11** is a flow diagram that describes steps in a method in accordance with one or more embodiments. Step **1100** renders a foundation. In some embodiments, the foundation includes a visual representation of a cluster. Step **1102** receives an indication of a user interaction with the foundation. Examples of user interaction with a foundation are discussed above and below. Step **1104** renders a flyout. In some embodiments, a flyout can be rendered responsive to receiving the indication of the user interaction with the foundation and/or the flyout can replace the foundation in a display view. Step **1106** receives an indication of a focus shift away from the flyout. For example, a cursor that is hovered over the flyout can be moved away from the flyout. In some embodiments, and responsive to receiving the indication of the focus shift away from the flyout, the method can return to step **1100**.

FIG. **12** is a flow diagram that describes steps in a method in accordance with one or more embodiments. In some embodiments, the method can be implemented to present information about a visual entity included in a cluster. Step **1200** renders a flyout. Step **1202** receives an indication of a user interaction with a visual entity included in the flyout. Examples of user interaction are discussed above and below. Step **1204** presents information about the visual entity responsive to receiving the indication of the user interaction.

A number of optional variations and additions to the methods and techniques discussed herein can be implemented to account for various operating scenarios. The following is a non-exclusive list of example optional variations and additions.

(1) The determination of visual entities to include in a cluster can be made using visual entities that are included in a display view during a current render pass.

(2) When a z-order for a visual entity or a cluster changes during a render pass, the z-order in existing clusters simply needs to be updated.

(3) When a change during a render pass simply involves the addition of a visual entity, determine if there is overlap of the added visual entity with existing visual entities.

(4) When a change during a render pass simply involves a zoom operation, re-cluster using existing clusters.

(5) For a particular render pass, simply re-render a cluster (e.g., a foundation) if its entity set has changed.

(6) Locate and remove any duplicate visual entities. For example, if multiple map entries are created for a single business entity, all but one of the entries can be removed from the system.

While certain embodiments are discussed herein with reference to utilizing a flyout to disambiguate clustered entities, this is not intended to be limiting. In some embodiments, a user interaction with a foundation can cause a zoom-in operation that reveals individual entities included in a cluster. For example, when a user interacts with a foundation included as part of a display view, the display view can automatically zoom-in on the area of the foundation such that the visual entities represented by the foundation no longer overlap and are displayed as separate visual entities.

Alternatively or additionally, in some embodiments user interaction with a foundation can cause a list of entities represented by the foundation to be presented. For example, when a user interacts with a foundation included as part of a display view, a list of entities represented by the foundation can be displayed in a window that is included as part of or is adjacent to the display view.

Having described example ways of constructing and interacting with clusters, consider now various embodiments that illustrate example ways of using annotations to indicate overlapping data sets.

Representation of Overlapping Visual Entities

In at least some embodiments, overlapping visual entities can be represented via a combined visual entity. In some example scenarios, overlapping visual entities can be associated with multiple data sets that can be layered to create a display view. For example, as discussed above with respect to a mapping scenario, multiple layers of map data can be

overlaid to generate a particular map view. To aid in visualizing multiple layered data sets, annotations for visual entities can be utilized.

FIG. **13** illustrates one example implementation of using annotations to visualize multiple layers of data sets according to some embodiments. A first layer view which includes multiple visual entities is illustrated generally at **1300**. In this particular example, first layer view **1300** includes multiple visual entities that represent restaurants in a particular geographical area, as illustrated by the "R" icons. A second layer view is illustrated generally at **1302** and includes multiple visual entities that are different from those illustrated in first layer view **1300**. In this particular example, second layer view **1302** includes multiple visual entities that represent business entities that accept a particular payment method (e.g., a particular credit card), as illustrated by the "$" icons. An overlapping layer view is illustrated generally at **1304** and includes visual entities from first layer view **1300** and second layer view **1302**, as well as combined visual entities that represent overlap between the layer views. For example, a combined visual entity **1306** represents overlap between first layer view **1300** and second layer view **1302**. In some embodiments, combined visual entity **1306** represents a restaurant that accepts the particular payment method indicated by the "$" symbol. In this particular example embodiment, the visual entity that represents a restaurant is annotated with the "$" symbol to indicate overlap between the different layers.

In at least some embodiments, methods discussed above for forming clusters can be utilized to determine when annotations should be used to indicate overlapping data sets. For example, the technique discussed above with respect to FIG. **8** can be utilized to determine that visual entities associated with multiple different data sets overlap. A visual entity can be displayed with annotations to indicate the overlap of the multiple visual entities.

In some embodiments, a combined visual entity can include a foundation. For example, a foundation can be displayed with annotations to visually indicate that multiple visual entities (e.g., in multiple data layers) overlap. Responsive to a user interaction with the annotated foundation, a flyout can be presented that displays the separate visual entities that are represented by the annotated foundation.

FIG. **14** displays an example combined visual entity in accordance with some embodiments, generally at **1400**. Combined visual entity **1400** includes a primary visualization **1402** and annotations **1404**, **1406**, and **1408**. In this particular example embodiment, primary visualization **1402** represents a business entity associated with lodging. The annotations represent other data layers that overlap with the primary visualization **1402**. For example, annotation **1404** represent a coffee shop, annotation **1406** represents an entity that accepts a particular payment method, and annotation **1408** represents a dining establishment. Thus, combined visual entity **1400** presents a visual indication of an overlap between these particular data sets.

Alternatively or additionally to the symbol and/or character-based annotation of a combined visually entity, color can also be used as a visual indicator for a combined visual entity. For example, a particular color can be associated with a particular overlap of visual entities and/or data layers and can indicate to a viewer that the combined visual entity represents the particular visual entities.

FIG. **15** is a flow diagram that describes steps in a method in accordance with one or more embodiments. In some embodiments, the method can be implemented to register visualizations that can be used to indicate overlapping data sets. Step **1500** registers a default visualization for a visual entity. According to some embodiments, the default visualization can be used when the visual entity is a primary visualization for a particular region of a display view. Step **1502** registers an annotation for the visual entity. In some embodiments, the annotation can be used to annotate a primary visualization for a different visual entity to indicate overlap between the visual entity and the different visual entity.

FIG. **16** is a flow diagram that describes steps in a method in accordance with one or more embodiments. As discussed above, in some embodiments visual entities may be associated with different layers of data. Thus, at least in some embodiments the method can be utilized to render a combined visual representation of entities from multiple different data layers. Step **1600** ascertains a position for each visual entity to be rendered. As discussed above, in some embodiments the position can be in terms of a screen position (e.g., an x-coordinate, a y-coordinate, and so on), geographical coordinates, and so on. Step **1602** determines that multiple visual entities overlap. Step **1604** retrieves a visualization for each of the overlapping visual entities. The visualization for each entity can be a primary visualization and/or an annotation. Step **1606** renders a combined visual entity that includes visualizations for the multiple overlapping visual entities. In some embodiments, the combined visual entity can include a primary visualization for one of the overlapping visual entities and one or more annotations for others of the overlapping visual entities.

FIG. **17** is a flow diagram that describes steps in a method in accordance with one or more embodiments. Step **1700** determines that multiple visual entities overlap. Step **1702** renders a combined visual entity that includes visualizations for the multiple overlapping visual entities. In some embodiments, the combined visual entity can include a primary visualization and one or more annotations.

Step **1704** receives an indication of a zoom-in operation. In at least some embodiments, the zoom-in operation can occur responsive to user interaction with an application such as a mapping application. Step **1706** determines that a visual entity of the multiple overlapping visual entities no longer overlaps. Step **1708** removes the visual entity from the combined visual entity. In some embodiments, this step can include removing an annotation from the combined visual entity or replacing a primary visualization associated with the combined visual entity.

While several of the example embodiments discussed herein are discussed with respect to a map implementation, it is to be appreciated that methods, techniques, and visualizations discussed herein can be applied in other scenarios without departing from the spirit and scope of the claimed embodiments. For example, clusters can be formed that represent groups of data files, instances of media content, flow charts, schematics, groups of persons at a particular location, and/or other entities to which the methods, techniques, and visualizations discussed herein can be applied.

Example System

FIG. **18** illustrates an example computing device **1800** that can be used to implement the various embodiments described above. Computing device **1800** can be, for example, computing device **102** of FIG. **1** or any other suitable computing device.

Computing device **1800** includes one or more processors or processing units **1802**, one or more memory and/or storage components **1804**, one or more input/output (I/O) devices **1806**, and a bus **1808** that allows the various components and devices to communicate with one another.

Bus **1808** represents one or more of any of several types of bus structures, including a memory bus or memory controller, a peripheral bus, an accelerated graphics port, and a processor or local bus using any of a variety of bus architectures. Bus **1808** can include wired and/or wireless buses.

Memory/storage component **1804** represents one or more computer storage media. Component **1804** can include volatile media (such as random access memory (RAM)) and/or nonvolatile media (such as read only memory (ROM), Flash memory, optical disks, magnetic disks, and so forth). Component **1804** can include fixed media (e.g., RAM, ROM, a fixed hard drive, etc.) as well as removable media (e.g., a Flash memory drive, a removable hard drive, an optical disk, and so forth).

One or more input/output devices **1806** allow a user to enter commands and information to computing device **1800**, and also allow information to be presented to the user and/or other components or devices. Examples of input devices include a keyboard, a cursor control device (e.g., a mouse), a microphone, a scanner, and so forth. Examples of output devices include a display device (e.g., a monitor or projector), speakers, a printer, a network card, and so forth.

Various techniques may be described herein in the general context of software or program modules. Generally, software includes routines, programs, objects, components, data structures, and so forth that perform particular tasks or implement particular abstract data types. An implementation of these modules and techniques may be stored on or transmitted across some form of computer readable media. Computer readable media can be any available medium or media that can be accessed by a computing device. By way of example, and not limitation, computer readable media may comprise "computer-readable storage media".

"Computer-readable storage media" include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules, or other data. Computer-readable storage media include, but are not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by a computer. Thus, whereas computer readable media may include signals per se, computer-readable storage media does not include signals per se.

CONCLUSION

Various embodiments enable overlapping visual entities to be grouped into a cluster that can be opened to reveal individual entities that form the cluster. According to one or more embodiments, a cluster is represented on a map or other application display by a visual representation known as a foundation. A user can interact with the foundation to cause the cluster to be opened to reveal a flyout that includes individual entities (e.g., geographic locations) that form the cluster. A user can also interact with an individual entity of the flyout to acquire more information about the individual entity. In at least some embodiments, a foundation can be annotated to indicate one or more entities in a cluster.

Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

What is claimed is:

1. A method comprising:

determining that a first visual entity associated with a first data layer overlaps with a second visual entity associated with a second data layer, the second data layer defined by an end-user; and

rendering in response to said determining a combined visualization that represents overlap of the first visual entity and the second visual entity.

2. The method of claim **1**, wherein the first visual entity and the second visual entity represent one or more geographical locations.

3. The method of claim **1**, wherein the first visual entity and the second visual entity represent one or more business entities.

4. The method of claim **1**, wherein the combined visualization comprises a primary visualization that represents the first visual entity, and an annotation that represents the second visual entity.

5. The method of claim **1**, wherein the first visual entity and the second visual entity are each associated with respective x-coordinates in a display region, and wherein the first visual entity and the second visual entity are included in the combined visualization based on the respective x-coordinates for the first visual entity and the second visual entity exceeding a threshold x-coordinate overlap.

6. The method of claim **1**, wherein the first visual entity and the second visual entity are each associated with respective y-coordinates in a display region, and wherein the first visual entity and the second visual entity are included in the combined visualization based on the respective y-coordinates for the first visual entity and the second visual entity exceeding a threshold y-coordinate overlap.

7. The method of claim **1**, wherein the first visual entity and the second visual entity are each associated with respective x-coordinates in a display region, and wherein the first visual entity and the second visual entity are included in the combined visualization based on the respective x-coordinates for the first visual entity and the second visual entity exceeding a threshold x-coordinate overlap measured in pixels.

8. The method of claim **1** further comprising:

receiving an indication of a user interaction with the combined visualization; and

responsive to receiving the indication of the user interaction with the combined visualization, causing information about data entities represented by the first visual entity and the second visual entity represented by the combined visualization to be displayed.

9. The method of claim **1**, wherein the first data layer and the second data layer are related to a same business entity.

10. A system comprising:

one or more processors; and

one or more computer readable storage media storing computer-executable instructions that that are executable by the one or more processors to cause the system to perform operations including:

ascertaining that a visualization of a data entity at least partially overlaps with visualizations of multiple other data entities;

determining that the data entity has provided an indication to opt out of clustering as part of a registration process; and

rendering a combined visualization of the multiple other data entities and omitting the data entity from the combined visualization in response to the indication that the data entity has opted out of clustering.

11. The system of claim **10**, wherein the visualization of the data entity and the visualizations of the multiple other data entities are each associated with respective x-coordinates in a display region, and wherein said ascertaining comprises determining the visualization of the data entity and the visualizations of the multiple other data entities exceed a threshold x-coordinate overlap.

12. The system of claim **10**, wherein the visualization of the data entity and the visualizations of the multiple other data entities are each associated with respective y-coordinates in a display region, and wherein said ascertaining comprises determining the visualization of the data entity and the visualizations of the multiple other data entities exceed a threshold y-coordinate overlap.

13. The system of claim **10**, wherein the data entity and the multiple other data entities represent business entities.

14. The system of claim **10**, wherein the operations further include rendering the visualization of the data entity separate from the combined visualization.

15. A computer-implemented method comprising:

determining by a computing system that visualizations for a group of data entities belonging to multiple layers visually overlap in a display by at least a threshold amount; and

rendering by the computing system a visual representation of a cluster representing the data entities of the group, the visual representation of the cluster including a primary visualization representative of a layer of the multiple layers to which one of the data entities belongs, and one or more visual annotations representing one or more other layers of the multiple layers to which one or more other data entities of the group belong.

16. The computer-implemented method of claim **15**, further comprising causing a flyout that individually represents the data entities to be displayed responsive to a user interaction with the visual representation of the cluster.

17. The computer-implemented method of claim **15**, wherein the threshold amount is measured in pixels.

18. The computer-implemented method of claim **15**, wherein the threshold amount is measured in geographic coordinates.

19. The computer-implemented method of claim **15** further comprising:

determining that a number of the data entities included in the cluster exceeds a maximum number; and

breaking the cluster into two or more clusters.

20. The computer-implemented method of claim **15** further comprising updating, responsive to said determining, at least one of: a layer membership, a cluster membership, or a z-order related to one entity of the data entities of the cluster.

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